

20 electrical circuit terminal.

45. **(Once Amended)** An electro-optic module for communicating optical signals between at least two electrical circuit terminals, comprising:

at least one substrate, wherein each substrate is selected from the group consisting of substrates with passive polymer waveguides, substrates with electro-optic elements

5 embedded in a polymer film, substrates having embedded electrical elements, and substrates having passive polymer waveguides and embedded electrical and electro-optic elements;

a first electrical circuit terminal disposed on one of the substrates, said first electrical circuit terminal coupled to a first integrated circuit chip to receive electrical signals therefrom;

10 a second electrical circuit terminal disposed on one of the substrates, said second electrical circuit terminal coupled to a second integrated circuit chip to provide electrical signals thereto;

optical waveguide means in at least one of the substrates for propagating optical signals;

15 optical switch means in at least one of the substrates for switching optical power or an optical signal in at least one of the substrates according to the electrical signals received at said first electrical circuit terminal; and

20 optical detection means in at least one of the substrates for detecting said switched optical power or switched optical signal and generating electrical signals therefrom which are coupled to said second electrical circuit terminal.

Attached hereto is a marked-up version of the changes made to the claims and specification by the current amendment. The attached page is captioned "Version with markings to show changes made".

REMARKS

The above amendments are made in response to the Office Action mailed November 20, 2002, wherein:

1. Claim 1 was rejected under 35 U.S.C. §112, second paragraph, for not having

- antecedent basis for "said first optical coupler";
2. Claim 41 was rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,323,373 to Horimai (the "Horimai patent");
 3. Claims 42-48 were rejected under 35 U.S.C. §102(e) as being obvious over the Horimai patent in view of U.S. Patent No. 6,141,465 to Bischel (the "Bischel patent"); and
 4. Claims 1-18 were indicated as being allowable if Claim 1 were corrected.

Applicants respectfully thank the Examiner for finding the antecedence basis error in Claim 1, and respectfully acknowledge with appreciate the indication that Claim 1 would be allowable if corrected, and that Claims 2-18 had patentable subject matter. With this Amendment, Applicants have amended Claim 1 to change "said first optical coupler" to "said first vertical optical coupler" in order to have proper antecedent basis to the recitation of "a first vertical optical coupler" in the fifth line of Claim 1. In addition, Applicants have provided amendments to independent Claims 41 and 45 to overcome the remaining rejections. Those amendments and remarks for overcoming the rejections of Claims 41-48 are provided below. **Claims 1-18 and 41-48 are pending in the application.**

Response to the Rejection of Claim 41

Claim 41 has been amended to focus it and its dependent claims to optical communications between integrated circuit chips, such as by the topologies shows in FIGS. 33-37, 110, 130-146 of the present application. Amended Claim 41 now recites as additional elements:

- (a) a first electrical circuit terminal disposed on one of the substrates, the first electrical circuit terminal coupled to a first integrated circuit chip to receive electrical signals therefrom, and
- (b) a second electrical circuit terminal disposed on one of the substrates, the second electrical circuit terminal coupled to a second integrated circuit chip to provide electrical signals thereto.

In addition, the optical signal source means of Claim 41 has been amended to indicate that

the optical signals generated by it are generated according to the electrical signals received at the first electrical circuit terminal. Finally, the optical detection means of Claim 41 has been amended to indicate that it generates *electrical* signals from the received *optical* signal and couples the generated electrical signals to the second electrical circuit terminal. Specific support for the amendments is provided after this section.

M.P.E.P. § 706.02(j) states the three basic requirements for establishing a *prima facie* case of obviousness:

“[t]o establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant’s disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).”

If any one of the three criteria is not present, the *prima facie* case fails, and the claim is *non-obvious*. For the reasons indicated below, Applicant respectfully submits that the Horimai patent does not teach or suggest all of the limitations of amended Claim 41 (e.g., all of the elements and features of Claim 41), and that there is not suggestion or motivation to modify the Horimai patent to include all of the limitations of amended Claim 41.

Applicants respectfully submit that the Horimai patent does not teach or suggest the additional features added to Claim 41. Specifically, the Horimai patent does not teach or suggest a first electrical circuit terminal disposed on a substrate, and coupled to a first integrated circuit chip to receive the chip's electrical signals, with the first electrical circuit terminal being combined with an optical signal source means which uses these electrical signals from the first chip to generate its optical signals. In addition, the Horimai patent does not teach or suggest an optical detection means disposed in a substrate which receives these optical signals and generates thereforem electrical signals, with the optical detection means being combined with a second electrical circuit terminal disposed on a substrate which receives these electrical signals and provides them to a second integrated circuit chip.

Applicants further respectfully submit that it would not be obvious to add these

features to the Horimai patent because there is no motivation to do so. The Horimai patent is directed to an optical pick-up device for communicating information to and from a magneto-optical recording medium. There is no indication in the Horimai patent for a need of communications between two integrated circuit chips by way of an optical signal that is initially generated from an electrical signal from the first chip, and then detected and converted to a second electrical signal that is provided to the second chip. Information in the Horimai device is communicated to and from a magneto-optical recording medium, not an integrated circuit chip. Therefore, there is no need or motivation to modify the Horimai device to include the features which have been added to amended Claim 41.

Accordingly, Applicants respectfully submit that amended Claim 41 is not taught or suggested by the Horimai patent, and respectfully submit that amended Claim 41 and its dependent Claims 42-44 are patentable over the Horimai patent. Accordingly, Applicants respectfully request that the Rejection be withdrawn.

Support for the Amendments to Claim 41

There are a number of embodiments of the application which support the amendments to Claim 41. One, for example, is shown by FIG. 33 and described by the Specification at page 56, line 24 through page 57, line 15.

FIG. 33 shows a schematic cross-sectional view of a chip layer 350 attached to an active substrate 320. The chip layer 350 comprises two integrated circuit chips 351 and 352 encapsulated in a dielectric film, and the active substrate 320 comprises a VCSEL light-emitter device 336 and a photo-detector device 328 which are optically coupled to a waveguide 324a in the active substrate 320. The VCSEL emitter device 336 is controlled by chip 351, and transmits an optical signal to waveguide 342a by way of a vertical coupler 344. Waveguide 324a conveys the signal to a transmitting vertical coupler 348, which directs the light signal to photo-detector device 328. As noted on pages 56-57 of the Specification, chip layer 350 and active substrate 320 convey electrical signals to one another through opposing contact pads 332 which are electrically coupled to one another. Contact pads 332 are specific examples of electrical circuit terminals, which is the generic terminology used in the first paragraph of Claim 41. An electrical output of the photo-

detector device 328 is electrically coupled to circuitry on second IC chip 352 by way of an electrical contact pad 332 disposed on the bottom of photo-detector 328. In a similar manner, an electrical input of VCSEL device 336 is electrically coupled to circuitry on the first IC chip 351 by way of a corresponding electrical contact pad 332 disposed on the bottom of VCSEL device 336. Thus, in view of FIG. 33 and its description in Specification at page 56, line 24 through page 57, line 15, Applicants respectfully submit that the amendments to Claim 41 are supported by the application as originally filed, and that no new matter has been entered by these amendments.

Response to the Rejection of Claim 45

Like Claim 41, Claim 45 has been amended to focus it and its dependent claims to optical communications between integrated circuit chips, such as by the topologies shown in FIGS. 33-37, 110, 130-146 of the present application. Amended Claim 45 now recites as additional elements:

- (a) a first electrical circuit terminal disposed on one of the substrates, the first electrical circuit terminal coupled to a first integrated circuit chip to receive electrical signals therefrom,
- (b) a second electrical circuit terminal disposed on one of the substrates, the second electrical circuit terminal coupled to a second integrated circuit chip to provide electrical signals thereto, and
- (c) optical detection means in at least one of the substrates for detecting the switched optical power or switched optical signal and generating electrical signals therefrom which are coupled to the second electrical circuit terminal.

In addition, the optical switch means of Claim 45 has been amended to indicate that its switching operation is performed according to the electrical signals received at the first electrical circuit terminal. Specific support for the amendments is provided after this section.

Applicant respectfully submits that neither of patents to Horimai and Bischel teaches or suggests all of the claims elements of amended Claim 45, and that there is no suggestion or motivation to modify the Horimai patent (the primary reference) to include all of the

features of amended Claim 45. Specifically, neither of patents to Horimai and Bischel teaches or suggests a first electrical circuit terminal disposed on a substrate, and coupled to a first integrated circuit chip to receive the chip's electrical signals, with the first electrical circuit terminal being combined with an optical switch means which switches the optical power or optical signal according to these electrical signals from the first chip. In addition, neither of patents to Horimai and Bischel teaches or suggests an optical detection means disposed in a substrate which receives the switched optical power or the switched optical signal and generates therefrom electrical signals, with the optical detection means being combined with a second electrical circuit terminal disposed on a substrate which receives these electrical signals and provides them to a second integrated circuit chip.

Applicants further respectfully submit that it would not be obvious to add these features to the Horimai patent (the primary reference) because there is no motivation to do so. The Horimai patent is directed to an optical pick-up device for communicating information to and from a magneto-optical recording medium. There is no indication in the Horimai patent for a need of communications between two integrated circuit chips by way of a switched optical power source or switched optical signal that is initially generated based on an electrical signal from the first chip, and then detected and converted to a second electrical signal that is provided to the second chip. Also, there is no suggestion of this type of communication in the Bischel patent. Information in the Horimai device is communicated to and from a magneto-optical recording medium, not an integrated circuit chip. Therefore, there is no need or motivation to modify the Horimai device to include the features which have been added to amended Claim 45.

Accordingly, Applicants respectfully submit that amended Claim 45 is not taught or suggested by the Horimai and Bischel patents, and respectfully submit that amended Claim 45 and its dependent Claims 46-48 are patentable over the *prima facie* combination of the Horimai and Bischel patents. Accordingly, Applicants respectfully request that the Rejection be withdrawn.

Support for the Amendments to Claim 45

There are a number of embodiments of the application which support the

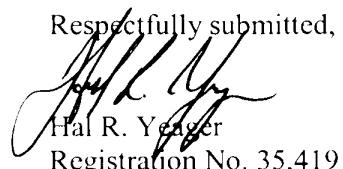
amendments to Claim 45. Applicants detail one of those here. Claim 45 recites all of the features of Claim 41 except that Claim 45 recites an optical switch means in place of an optical signal source means. Claim 45 is supported by FIG. 33 (and its description on pages 56-57 of the Specification) for the same reasons that Claim 41 is supported, as modified by the substitute of the switch modulator configuration shown in FIG. 37-3 for VCSEL element 336 shown of FIG. 33. The embodiments shown in FIGS. 33-37 are described as a common technology group in pages 56- 62 of the present Specification. The paragraph at page 59, line 19 through page 60, line 14 describes various light emitters and switches in FIGS. 37-1 through 37-4, which can be used in the embodiments of FIGS. 33-36. FIG. 37-3 shows an optical switch means that comprises a modulator 3xx which selectively switches the amount of power that waveguide 324a receives from an optical power source 333, which may also be an optical signal source 333. Accordingly, Applicants respectfully submit that the amendments to Claim 45 are supported by the application as originally filed, and that no new matter has been entered by these amendments.

CONCLUSION

In view of the remarks made above, applicants respectfully submit that the application is in condition for allowance and action to that end is respectfully solicited. If the Examiner should feel that a telephone interview would be productive in resolving issues in the case, he is invited to telephone the undersigned at the number listed below.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made".

Respectfully submitted,



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"Version with Markings to Show Changes Made"

Additions are shown by **bold double underlining**, deletions are shown with **strikeout type**.

In the Claims:

Claims 1, 41, and 45 have been amended as follows:

1. **(Once Amended)** A substrate having optical and electrical interconnections, comprising:

a first layer having a first polymeric waveguide formed therein;

a second layer having a second polymeric waveguide formed therein;

5 a first vertical optical coupler formed in said first layer and optically coupled to a first waveguide in said first layer;

a second vertical optical coupler formed in said second layer and optically coupled to a second waveguide in said layer;

10 wherein said first **vertical** optical coupler is positioned adjacent said second vertical optical coupler so that light may be coupled between said first and said second waveguides.

41. **(Once Amended)** An electro-optic module for communicating optical signals between at least two electrical circuit terminals, comprising:

at least one substrate, wherein each substrate is selected from the group consisting of substrates with passive polymer waveguides, substrates with electro-optic elements
5 embedded in a polymer film, substrates having embedded electrical elements, and substrates having passive polymer waveguides and embedded electrical and electro-optic elements;

10 **a first electrical circuit terminal disposed on one of the substrates, said first electrical circuit terminal coupled to a first integrated circuit chip to receive electrical signals therefrom;**

a second electrical circuit terminal disposed on one of the substrates, said second electrical circuit terminal coupled to a second integrated circuit chip to provide electrical signals thereto;

optical waveguide means in at least one of the substrates for propagating optical signals;

15 optical signal source means in at least one of the substrates for generating optical

signals in at least one of the substrates according to the electrical signals received at said first electrical circuit terminal; and

optical detection means in at least one of the substrates for detecting said optical signals and generating electrical signals therefrom which are coupled to said second electrical circuit terminal.

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45. (Once Amended) An electro-optic module for communicating optical signals between at least two electrical circuit terminals, comprising:

at least one substrate, wherein each substrate is selected from the group consisting of substrates with passive polymer waveguides, substrates with electro-optic elements
5 embedded in a polymer film, substrates having embedded electrical elements, and substrates having passive polymer waveguides and embedded electrical and electro-optic elements;

a first electrical circuit terminal disposed on one of the substrates, said first electrical circuit terminal coupled to a first integrated circuit chip to receive electrical signals therefrom;

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a second electrical circuit terminal disposed on one of the substrates, said second electrical circuit terminal coupled to a second integrated circuit chip to provide electrical signals thereto;

optical waveguide means in at least one of the substrates for propagating optical signals;

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optical switch means in at least one of the substrates for switching optical power or an optical signal in at least one of the substrates according to the electrical signals received at said first electrical circuit terminal; and

optical detection means in at least one of the substrates for detecting said optical signals and generating electrical signals therefrom which are coupled to said second electrical circuit terminal.

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